

FuelMaker Presentation to:

NGV TECHNOLOGY FORUM

November 19 – 20, 2008
Downey, CA



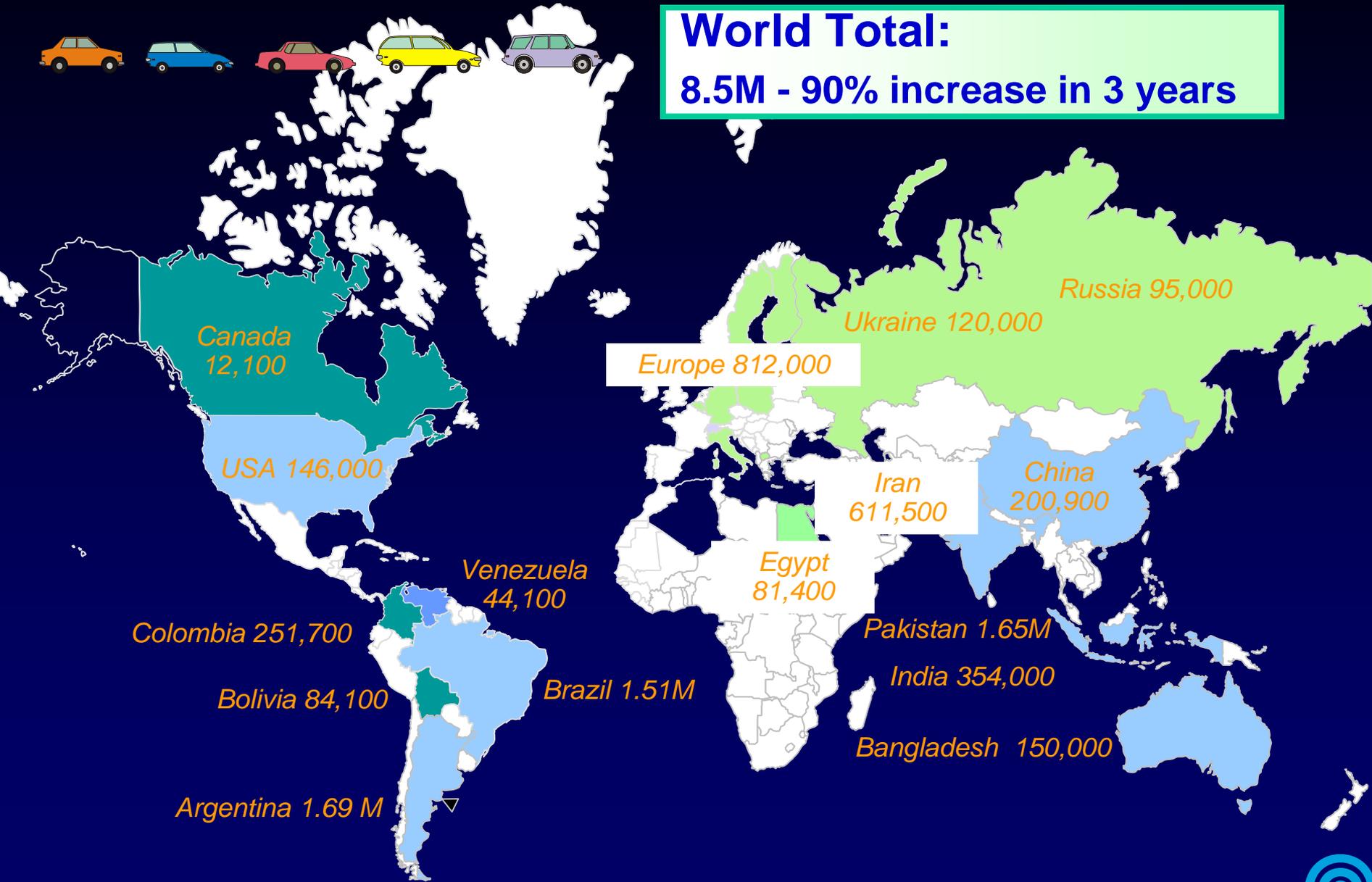
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Natural Gas Vehicles in the World (June 2008)



World Total:
8.5M - 90% increase in 3 years



OEM NGVs Available in Europe and North America

Europe

Citroën



C3



Berlingo



Jumper

Fiat



Ford



Focus Flexifuel



C-Max



Transit

Mercedes-Benz



E200 NGT

All European vehicles are bi-fuel.

OEM NGVs Available in Europe and North America (cont.)

Europe (cont'd)

Opel / GM



Zafira



Combo

Peugeot



Partner



206



Boxer

Renault



Clio

Volkswagen



Kangoo



Caddy



Touran

North America

Honda

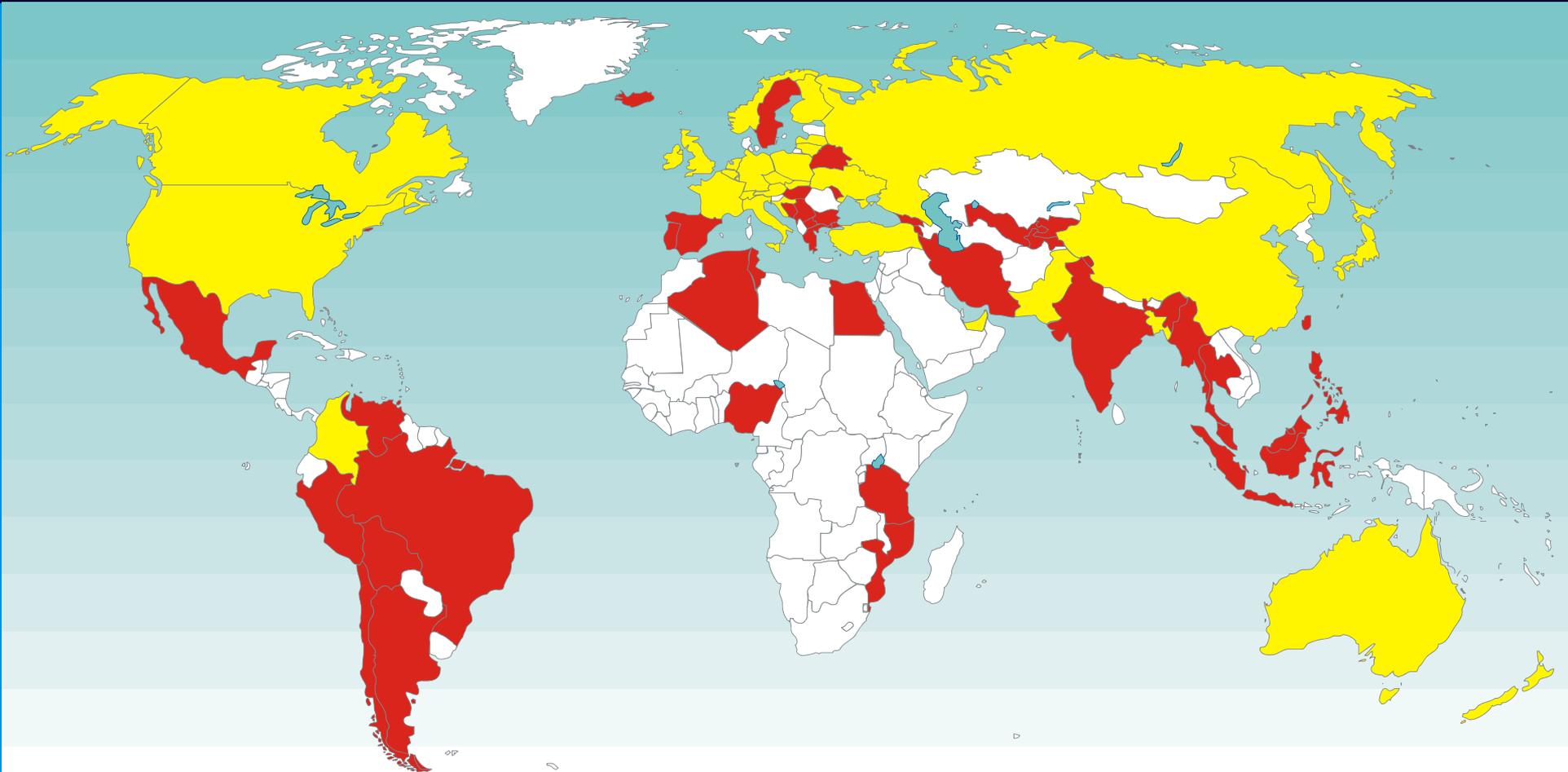


Civic GX

- Presently the only OEM NGV available in USA.

FuelMaker Worldwide Activity

- FuelMaker active areas in yellow (32 countries)
- 15,000 units in the world



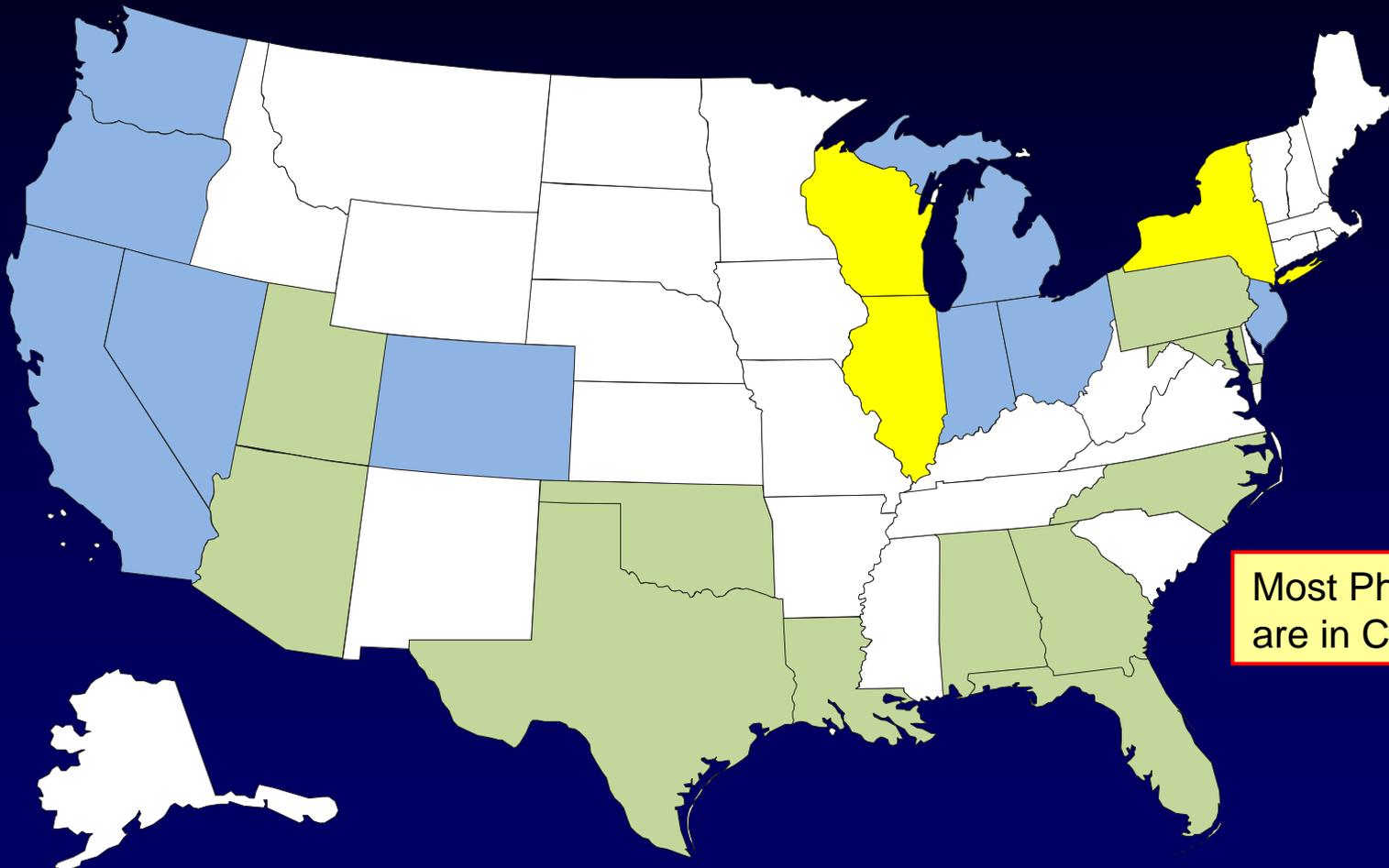
FuelMaker Worldwide Activity

Dealers, Installers, Evaluators

Total Countries	Country	VRA Dealers	VRA Evaluation Agreements	Phill Dealers	Phill Installers	Phill Evaluation Agreements	New Near Future Dealers
1	Australia	1				2	
2	Bangladesh	1					
3	Barbados					1	
4	Belgium	1		1			
5	Canada	8					
6	China	1		1			
7	Colombia		1				
8	Croatia						1
9	Czech	2		2			
10	Finland	1		1			
11	France			1			
12	Germany					7	
13	Indonesia	1					
14	Italy	1		1			
15	Japan	1				1	
16	Korea	1					
17	Latvia	1					
18	Lithuania	1		1			
19	Malaysia	1					
20	Netherlands	1		1			
21	Norway						1
22	Pakistan					1	
23	Poland	1		1			
24	Russia	1					
25	Singapore	1					
26	Slovakia						1
27	Switzerland			1			
28	Thailand	1					
29	Turkey	1					
30	UAE					1	
31	Ukraine	1					
32	USA	49		18	60		
	Total Dealers	75	1	29	60	13	3

Orange designates same dealer

FuelMaker USA Activity Phill Installer & Dealer Network



Most Phill sales are in California

Green states covered by dealers
Blue states covered by installers (FM direct sales)
Yellow states covered dealers & installers

FuelMaker Products

FuelMaker's full line of Vehicle Refueling Appliances provide an inexpensive and convenient way to refuel fleet vehicles. Five separate VRA models are available offering a wide range of refueling capabilities.



Fast-Fill Storage



**FMQ-8-36
FMQ-
10FMQ-7-42**



**FMQ-2-36
FMQ-2
FMQ-2.5**



**Phill P36
Phill P30**



**Auxiliary & Remote
Fueling Panels**

FuelMaker Markets and System Configuration

- Residential Market (Home Refueling)
 - Outdoor or Indoor
- Fleet Market
 - Time-Fill (Outdoor or Indoor)
 - Fast-Fill (Outdoor)
 - Combo-Fill (Outdoor)
 - Mini Fast-Fill with Metered Dispenser (Outdoor)
- Forklift Market
 - Fast-Fill (Outdoor or Indoor)
 - Time-Fill (Outdoor or Indoor)
- Ice Arena Market
 - Time Fill (Outdoor or Indoor)

Fleet Applications - Time-Fill



Fleet Applications - Fast-Fill



Public Stations – Mini Fast-Fill



Fleet Applications Combo-Fill



Forklift Applications Fast-Fill



Ice Arenas Time-Fill

- Over 600 ice arenas using FuelMaker



The 1st Affordable Home Refueling Appliance for Natural Gas Vehicles

Compact, quiet & easy to install,
Phill is the future of fueling

Phill can refuel both 3000
and 3600 psi vehicles

Refuel when it is
convenient, or overnight

Home refueling can help
break the chicken & egg
infrastructure cycle



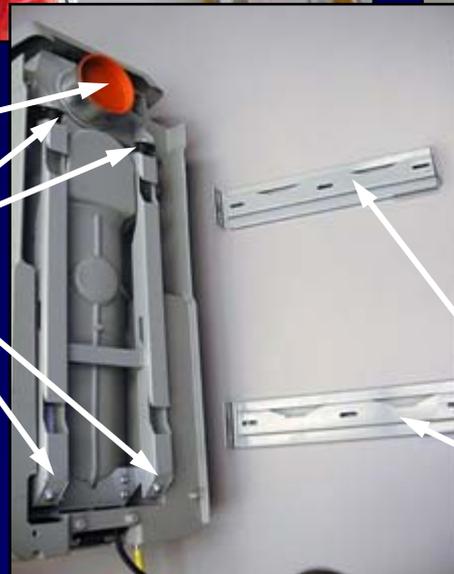
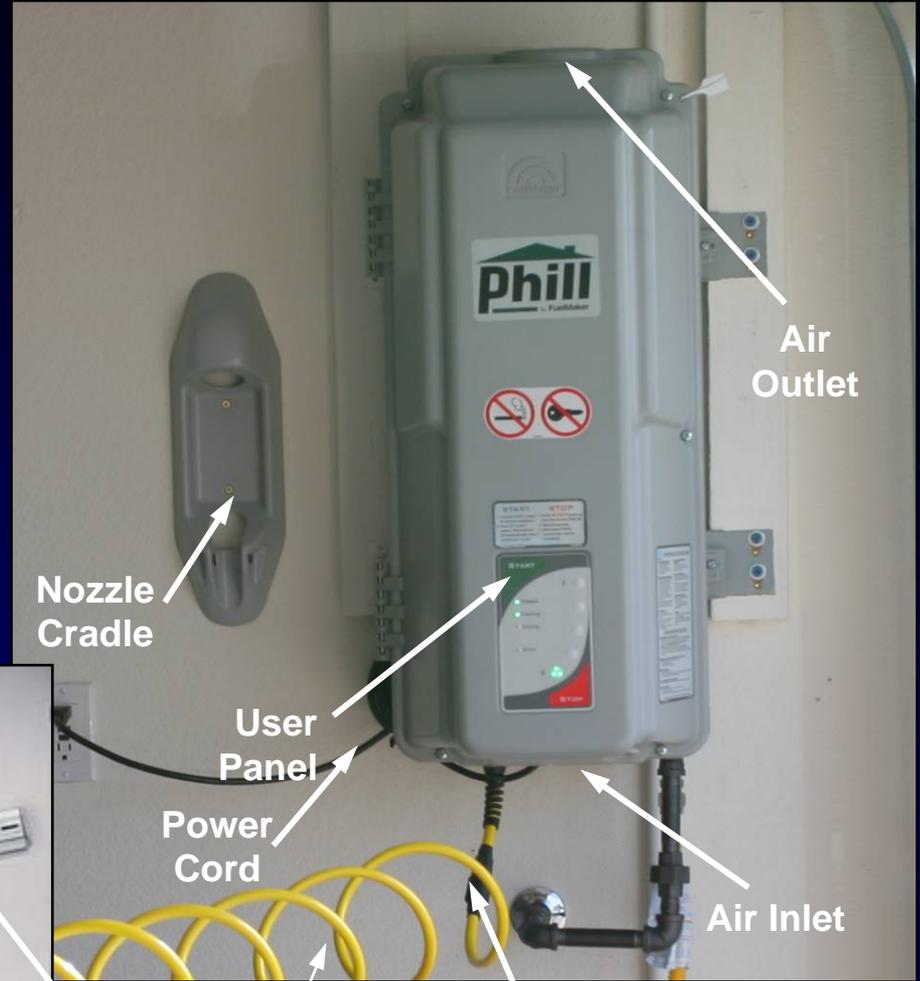
Phill's design is based on advanced FuelMaker technology and is backed by 100 patents and more than 20 years field experience. There are over 15,000 FuelMaker VRAs in service worldwide.

Phill Specifications



- Indoor / Outdoor Installation
- 240 VAC 60 Hz Single Phase
- 800 Watts
- General Purpose Electrical Rating
- Appliance Certified
- Integrated Gas Dryer, Gas Sensor, Exhaust Fan
- Maintenance-Free
- P30 or P36 Temperature Pressure Compensation
- 1 scfm (.42 GGE/hr) flow rate
- $\frac{1}{4}$ - $\frac{1}{2}$ psig Inlet Pressure
- 45 dBA @ 16.5 ft Sound Level
- General Purpose Electrical Rating

Phill Components



Rear View Prior to Installation

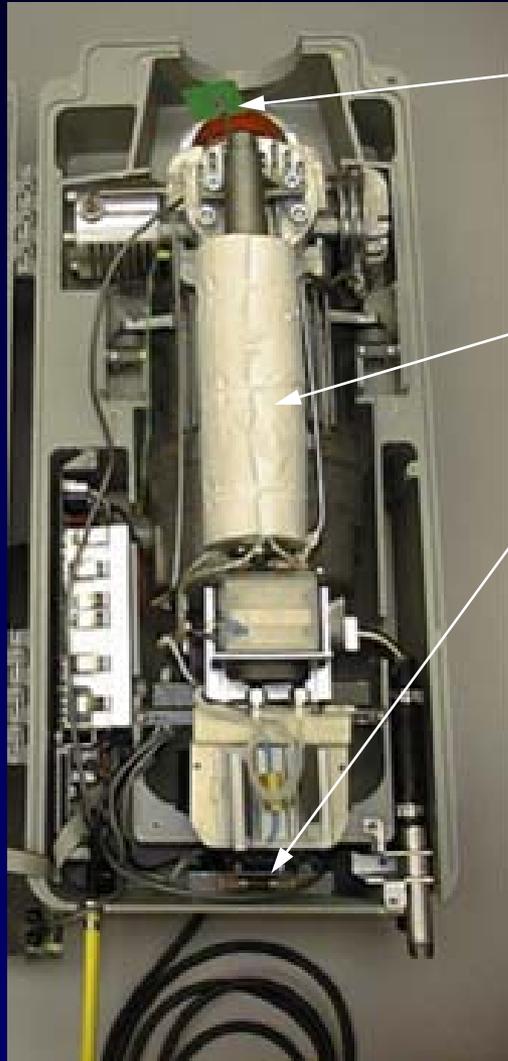
Hose / Nozzle Assembly

Breakaway

Mounting Brackets (Double Isolation)

Phill Components

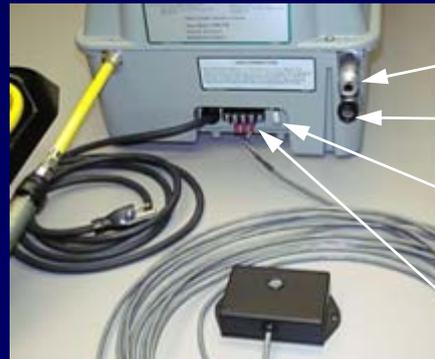
Phill with Inner Shroud Removed



Gas
Sensor & Air
Flow Switch

Dryer

Inlet Air
Temperature
Sensor



Gas Inlet

Vent Outlet

RS232 Port

Gas Sensor
Terminal Strip

Phill with Inner Shroud & Dryer Removed



Compression
Module

Motor

Controls
Module

Power Supply &
Main Controller

Fan

Introduction of Generation 1.5

Development and field testing has continued since the introduction of Phill in 2005. Significant technical breakthroughs have resulted in the development of the Phill Generation 1.5. Main features are:

- Simpler design
- Lower cost (at higher volumes)
- Reliability improvements

New 1st stage with Pressure and Solenoid Bypass Valves

Valve Connections



Pressure Bypass Valve



Solenoid Bypass Valve



New Dryer Connection



- Two Bypass Valves route gas flow around the Dryer allowing Dryer regeneration with single speed operation (full flow)
- Pressure bypass allows easy starting with single speed operation
- These changes allow the introduction of a single speed motor

New Electronics

The introduction of a single speed motor has allowed significant simplification to the electronics:

- Eliminates need for motor speed controller
- Power Supply is reduced in size and can be integrated onto Main Controller
- Compact design allows further integration: 4 printed circuit boards vs. 8 printed circuit boards.
- 240 Volt operation is chosen (elimination of 120 Volt, better efficiency)

New Microcontroller

New design allows the introduction of a new microcontroller - Atmel Mega325. The advantages are:

- Lower cost.
- Latest technology.
- Improved I/O protection.
- 5V operation for simpler device interfaces (LPT, HPT and etc.).
- Integrated 1kbyte EEPROM memory.
- Integrated voltage supervisor and watch-dog with separate oscillator.
- I/O boundary scan capabilities via JTAG - Production testing improvement: the JTAG can test all ports of the micro.

Four Circuit Boards Reduced to One

Gen 1.0 Power Supply Board



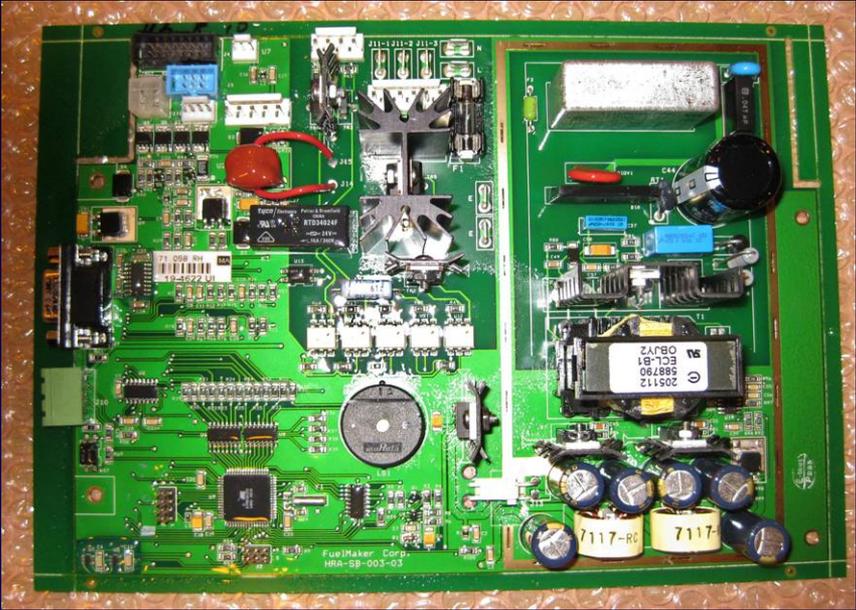
Gen 1.0 Ambient Air Temperature / Ext. Gas Detector



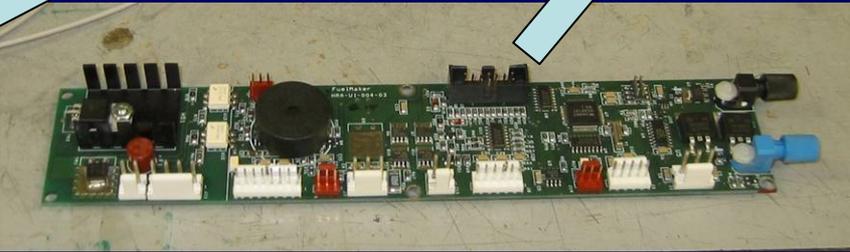
Gen 1.0 Variable Speed Motor Controller



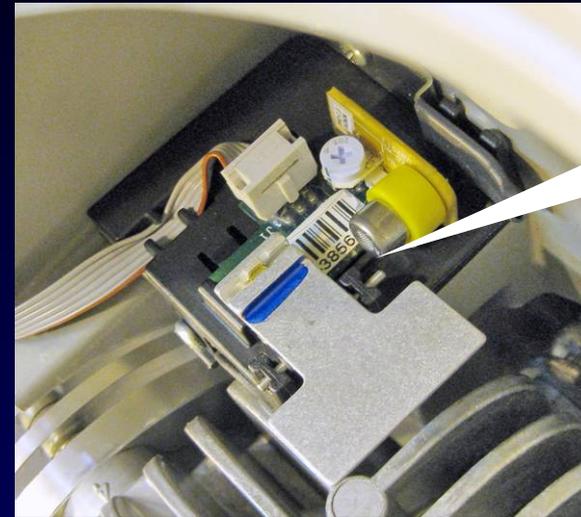
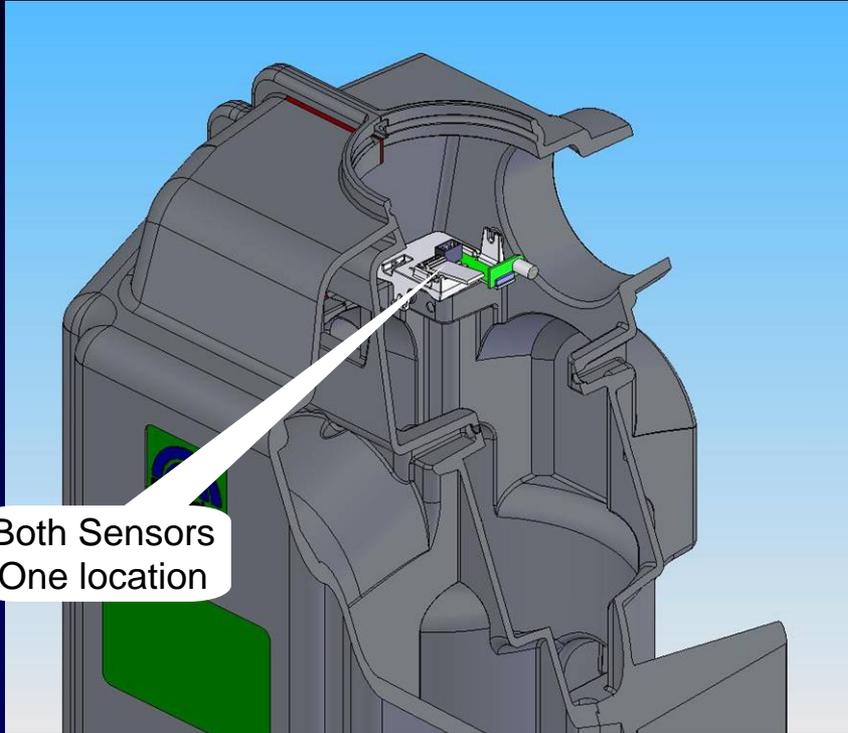
New Gen 1.5 Main Controller



Gen 1.0 Main Controller

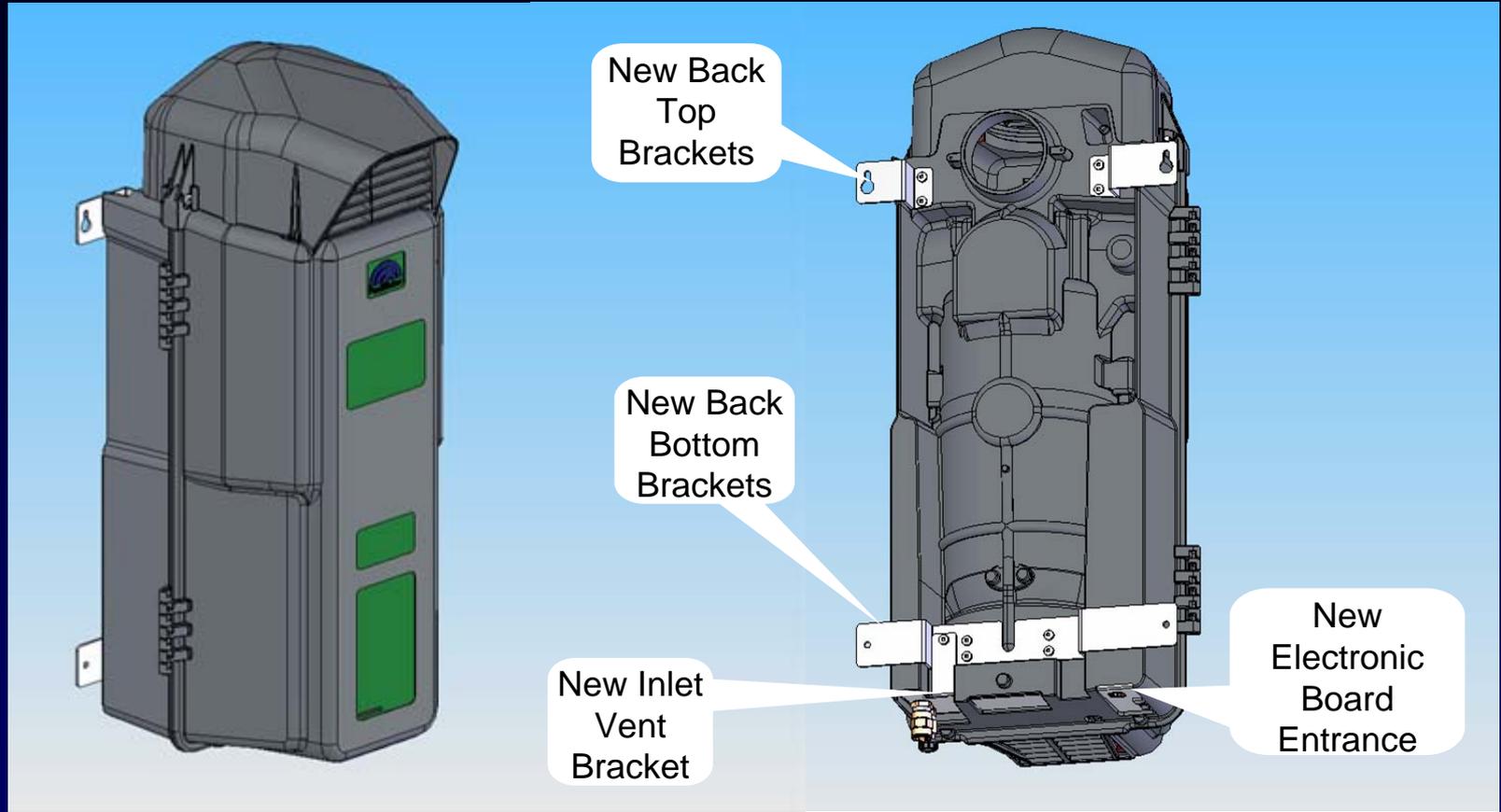


New Airflow & Gas Detector Assembly



- Gas Detector and Air Flow Switch are now mounted on a common circuit board and base for lower cost and simpler installation (less wiring)
- Air Flow sail is wider and heavier for resistance to effects of wind

New Mounting Brackets



- Simplified Mounting Arrangement through fixed brackets
- Double Isolation is available as an option

General Improvements

Other changes include:

- Single speed DC fan (simplified on/off fan circuit vs. controlled voltage output)
- Gas Detector analogue signal is output to external communications port. This allows remote monitoring of Gas Detector signal over extended time frame
- Plastic Housing modifications to allow simpler in-field modifications (hose change due to wear and tear)
- Simplified venting
- RoHS Compliant

Safety Features Improved or Unchanged

- Gas Detection (during running and idle states)
- Exhaust / Cooling Air Flow Detection
- Current Monitoring
- Temperature Monitoring
- Inlet Pressure Detection
- In-line break-away
- Resistant to 10 V/m EMI (Electromagnetic Interference)
- Hose, Nozzle and Receptacle Integrity Test (at beginning, during and end of refueling)
- Insufficient Pressure Rise Detection
- Sudden Pressure Drop Detection
- Excessive Blowdown Pressure Detection
- Blowback Monitoring

Certification

North America



European Union

Switzerland



France



Conclusion

- FuelMaker is recognized around the world as a leader in NGV compression technology
- Phill home-refueling appliance is an important contribution to the NGV industry & consumer market
- FuelMaker's wide range of appliance based Commercial Natural Gas Refueling Systems address the needs of the following markets:
 - Fleet vehicles
 - Forklifts
 - Ice resurfaces

Thank you

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